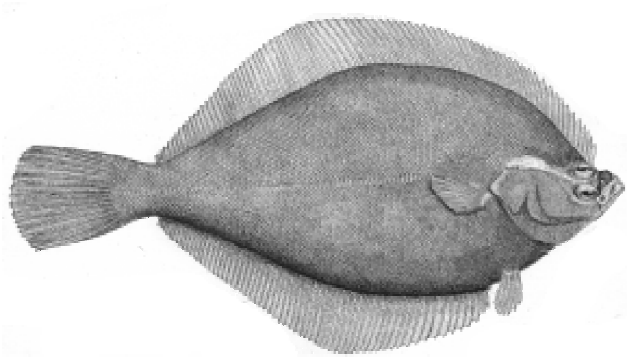

Yellowtail Flounder

by
Steven Cadrin

Yellowtail flounder, *Limanda ferruginea*, range from Labrador to Chesapeake Bay. Off the U.S. coast, commercially important concentrations are found on Georges Bank, off Cape Cod, and off southern New England, generally at depths between 40 and 70 m (20 to 40 fathoms). Some yellowtail are also caught in the Mid-Atlantic Bight and in the Gulf of Maine.

Off the northeast United States, yellowtail grow to 55 cm (22 in.) total length and attain weights of 1.0 kg (2.2 lb), but high rates of fishing mortality have greatly reduced average size and age. Yellowtail appear to be relatively sedentary, although seasonal movements have been documented. Spawning occurs during spring and summer, peaking in May. Larvae drift for approximately two months, then change form and settle to the bottom.

Four stocks of yellowtail flounder are recognized in U.S. waters, these being the Georges Bank, southern New England, Cape Cod and Mid-Atlantic stocks. Movement patterns and geographic variation in life history characteristics indicate the first three to be relatively discrete, with little intermingling, but movement between southern New England and the Mid-Atlantic units may be extensive.

The principal fishing gear used to catch yellowtail flounder is the otter trawl. Total landings of yellowtail flounder by the U.S. in 1998 were 3,600 mt, the highest since 1993. An additional 1,200 mt was taken by Canada on Georges Bank. Recreational landings of yellowtail are negligible.

The U.S. fishery is managed under the New England Fishery Management Council's Multispecies Fishery Management Plan (FMP). Under this FMP yellowtail are included in a complex of 15 groundfish species which has been managed by time/area closures, gear restrictions, minimum size limits, and, since 1994, direct effort controls including a moratorium on permits and days-at-sea restrictions under Amendments 5 and 7 to the FMP. Amendment 9 established biomass rebuilding targets, and defines control rules which specify target fishing mortality rates and corresponding rebuilding time horizons. The goal of the management

program is to reduce fishing mortality to levels which will allow stocks within the complex to initially rebuild above minimum biomass thresholds, and ultimately, to remain at or near target biomass levels. The Canadian fishery on Georges Bank is managed under an individual quota system.

Georges Bank

The Georges Bank yellowtail stock has been exploited since the late 1930s. Landings gradually increased to 7,300 mt in 1949, decreased to 1,600 mt in 1956, and subsequently increased again to an average of 13,600 mt during 1962-1976, some of which was taken by distant-water fleets. No yellowtail have been taken by distant-water fleets since 1977. Total landings declined to approximately 6,000 mt between 1978 and 1981, and then rose to more than 10,500 mt in 1982-1983, with strong recruitment and intense fishing effort. Landings then fell to a low of 1,100 mt in 1989, and averaged 2,800 mt from 1990 to 1994. U.S. landings dropped to 300 mt in 1995 under severe fishing restrictions including a year-round closure of a large portion of the Bank, but then steadily increased to 1,800 mt in 1998. Canadian landings were negligible before 1993, but increased to 2,100 mt in 1994, exceeding U.S. landings. Canadian landings decreased to 500 mt in 1995, when Canada imposed catch quotas for Georges Bank yellowtail, but subsequently increased to 1,200 mt in 1998.

Abundance indices from NEFSC spring and autumn bottom trawl surveys declined by about 10% per year from 1963 to 1989, remained at low levels from 1990 to 1994, and have subsequently increased.

Cooperative assessments with Canada indicate that stock biomass is rebuilding. Virtual population analysis or VPA indicates that the stock was abundant in the early 1970s and was supported by several strong year-classes. Stock size rapidly declined in the early to mid 1980s from poor recruitment and extremely high fishing mortality. However, increased survival and moderate recruitment have increased spawning biomass since 1994. Fishing mortality on fully-recruited ages was extremely high from 1973 to 1994, but steadily decreased from 2.3 (85% exploitation rate) in 1994 to less than 0.2 (16% exploitation rate) in 1998. The corresponding biomass-weighted F (0.10) for 1998 was below the management target to allow stock rebuilding ($F_{THRESHOLD}$). Spawning stock biomass declined from 21,000 mt in 1973 to less than 4,000 mt from 1984-1988. Spawning biomass fluctuated at levels less than 6,000 mt from 1989 to 1995, and then steadily increased to 17,300 mt in 1998. Total stock size (27,800 mt) is about 60% of the level that can produce maximum sustainable yield. The stock is considered to be rebuilding from an overfished state.

Summary Status

Long-term potential catch (MSY)	=	14,500 mt
Biomass corresponding to MSY	=	B_{MSY} = 49,000 mt
Minimum biomass threshold	=	$^1/_4 B_{MSY}$ = 12,250 mt
Stock Biomass in 1998	=	27,800 mt (Implies stock was not overfished)
F_{MSY}[1]	=	0.30
F_{TARGET}[1]	=	0.26
$F_{TARGET98}$[1]	=	0.21
Overfishing definition	=	$F_{THRESHOLD98}$[1, 2] = 0.25
F_{1998}[1]	=	0.10 (Implies overfishing was not occurring)
Age at 50% maturity	=	2.1 years, males 2.2 years, females
Size at 50% maturity	=	22.3 cm (8.8 in.), males 28.1 cm (11.1 in.), females
Assessment level	=	Age structured
Management	=	Multispecies FMP

M = 0.20 **$F_{0.1}$ = 0.25** **F_{max} = 0.82** **F_{1998} = 0.17**[3]

[1]Weighted by stock biomass at age

[2]$F_{THRESHOLD} = F_{MSY} = 0.30$ on biomass when biomass = B_{MSY}. When biomass is between B_{MSY} and $^1/_4 B_{MSY}$, $F_{THRESHOLD}$ is the maximum F that allows rebuilding to B_{MSY} in 10 years. When biomass is below $^1/_4 B_{MSY}$, $F_{THRESHOLD}$=0.

[3]For fully recruited ages

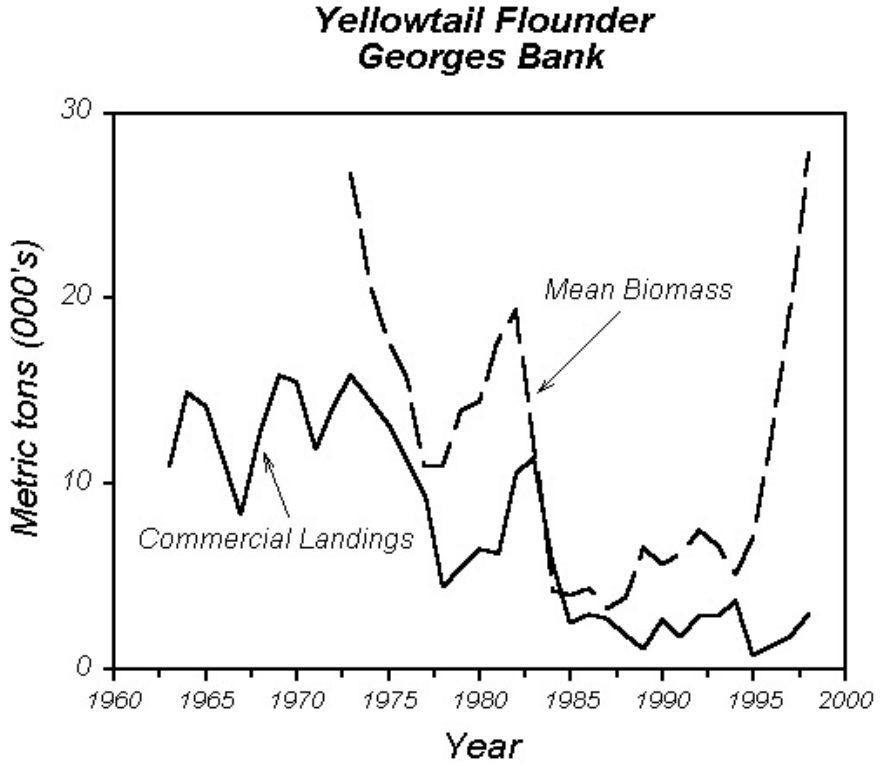

Table 7.1 Recreational catches and commercial landings (thousand metric tons)

Category	Year										
	1979-88 Average	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
U.S. recreational	-	-	-	-	-	-	-	-	-	-	-
Commercial											
United States	5.6	1.1	2.7	1.8	2.9	2.1	1.6	0.3	0.8	1.0	1.8
Canada	<0.1	-	-	-	<0.1	0.8	2.1	0.5	0.5	0.8	1.2
Other	<0.1	-	-	-	-	-	-	-	-	-	-
Total nominal catch	5.6	1.1	2.7	1.8	2.9	2.9	3.7	0.8	1.3	1.8	3.0

Southern New England

Landings of yellowtail flounder from the southern New England stock averaged 20,000 mt during 1963-1968 but declined abruptly after 33,200 mt were landed in 1969. Landings dropped to 8,900 mt in 1971 and remained low through the 1970s. Landings increased rapidly between 1981 and 1983 to 17,000 mt from strong recruitment of the 1980 year class. Landings subsequently declined to only 900 mt in 1988, rose to 8,000 mt in 1990 with recruitment of the strong 1987 year class, and have subsequently declined to less than 500 mt since 1993 under severe fishing restrictions, including a large, year-round area closure.

Abundance and biomass indices from the NEFSC autumn bottom trawl survey fluctuated at high levels between 1963 and 1972, but declined sharply in 1973. Survey indices increased briefly by recruitment of the strong 1980 and 1987 year classes, but were among the lowest on record in the intervening years. By 1993, the NEFSC autumn survey index had fallen to the lowest level in the 30-year series and has increased only slightly since then. Current abundance is less than 10% of levels observed in the late 1960s.

A recent assessment indicated that the stock has increased slightly since 1994, but remains at low levels. Fishing mortality on fully recruited ages fluctuated between 0.6 and 1.1 between 1973 and 1979, and averaged 1.5 per year (71% exploitation rate) from 1980 to 1996. During these years, yellowtail older than age 4 were rare in both commercial landings and bottom trawl survey catches. Fully-recruited fishing mortality declined to 0.20 (16% exploitation rate) in 1998. However, biomass weighted F (=0.09) still exceeds the management target chosen to allow stock rebuilding (F=0.0). Spawning stock biomass decreased from 21,900 mt in1989 to 400 mt in 1994, but has since increased to 3,600 mt in 1998. The current stock size is less than 10% of the level that can produce maximum sustainable yield. The stock is considered to be overfished, and overfishing was occurring in 1998.

Summary Status

Long-term potential catch (MSY)	=	14,200 mt
Biomass corresponding to MSY	=	B_{MSY} = 61,500 mt
Minimum biomass threshold	=	$^1/_4 B_{MSY}$ =15,375 mt
Stock Biomass in 1998	=	4,900 mt (Implies an overfished condition)
F_{MSY}[1]	=	0.23
F_{TARGET}[1]	=	0.22
$F_{TARGET98}$[1]	=	0.00
Overfishing definition	=	$F_{THRESHOLD98}$[1, 2] =0.00
F_{1998}[1]	=	0.09 (Implies overfishing was occurring)
Age at 50% maturity	=	2.1 years, males 2.2 years, females
Size at 50% maturity	=	23.2 cm (9.1 in.), males 28.3 cm (11.1 in.), females
Assessment level	=	Age structured
Management	=	Multispecies FMP

M = 0.20 **$F_{0.1}$ = 0.27** **F_{max} = 0.95** **F_{1998} = 0.20[3]**

[1]Weighted by stock biomass at age

[2]$F_{THRESHOLD} = F_{MSY} = 0.23$ on biomass when biomass = B_{MSY}. When biomass is between B_{MSY} and $^1/_4 B_{MSY}$, $F_{THRESHOLD}$ is the maximum F that allows rebuilding to B_{MSY} in 10 years. When biomass is below $^1/_4 B_{MSY}$, $F_{THRESHOLD} = 0$.

[3]For fully recruited ages

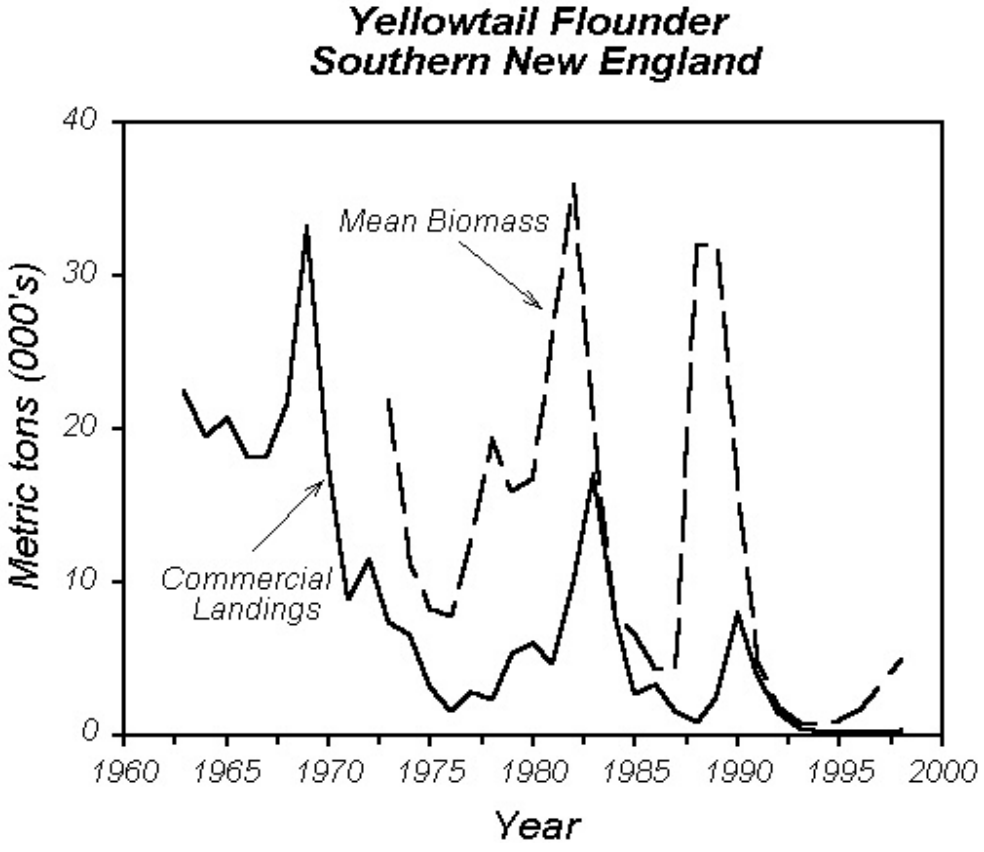

Table 7.2 Recreational catches and commercial landings (thousand metric tons)

Category	Year										
	1979-88 Average	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
U.S. recreational	-	-	-	-	-	-	-	-	-	-	-
Commercial											
United States	6.0	2.5	8.0	3.9	1.5	0.5	0.2	0.2	0.3	0.2	0.4
Canada	-	-	-	-	-	-	-	-	-	-	-
Other	-	-	-	-	-	-	-	-	-	-	-
Total nominal catch	6.0	2.5	8.0	3.9	1.5	0.5	0.2	0.2	0.3	0.2	0.4

Cape Cod

Traditionally, landings of yellowtail flounder from the Cape Cod stock have been a small fraction of the landings from southern New England and Georges Bank. Since 1993, however, landings from the Cape Cod stock have exceeded those from Southern New England and exceeded those from Georges Bank in 1995. This situation is more indicative of the degree of decimation of the other stocks rather than of growth of the Cape Cod stock. Landings of Cape Cod yellowtail fluctuated between 1,500 and 2,000 mt from the mid-1960s to the mid-1970s, increased to a record high of 5,100 mt in 1980, and then declined to only 600 mt in 1993. Landings from 1994-1998 averaged 1,100 mt.

Trends in abundance and biomass for this stock have been monitored by Massachusetts Division of Marine Fisheries (DMF) and NEFSC bottom trawl surveys. The Massachusetts DMF spring survey biomass index peaked in 1981, but then declined to one-third of peak levels by the late 1980s. The index increased during the early 1990s but has since declined. These trends are also generally reflected in the NEFSC bottom trawl surveys.

A 1999 assessment indicated that stock size has been increasing slightly in recent years. Fishing mortality on fully-recruited ages was extremely high and variable from 1985 to 1997, but decreased to 0.4 (31% exploitation rate) in 1998. However, biomass weighted F still exceeded the management target to allow stock rebuilding, indicating that overfishing was occurring. Spawning stock biomass peaked at 2,100 mt in 1990, briefly decreased, then gradually increased to 1,900 mt in 1998. Currently, stock biomass is only about half the level that can produce maximum sustainable yield. The stock is near an overfished state.

Summary Status

Long-term potential catch (MSY)	=	2,400 mt
Biomass corresponding to MSY	=	B_{MSY} = 6,100 mt
Minimum biomass threshold	=	$^1/_2 B_{MSY}$ = 3,050 mt
Stock Biomass in 1998	=	3,100 mt (Implies stock was not overfished)
F_{MSY}[1]	=	0.40
F_{TARGET}[1]	=	0.26
$F_{TARGET98}$[1]	=	0.00
Overfishing definition	=	$F_{THRESHOLD98}$[1, 2] = 0.18
F_{1998}[1]	=	0.41 (Implies overfishing was occurring)
Age at 50% maturity	=	2.1 years, males 2.7 years, females
Size at 50% maturity	=	23.7 cm (9.3 in.), males 26.8 cm (10.6 in.), females
Assessment level	=	Age structured
Management	=	Multispecies FMP

M = 0.20 **$F_{0.1}$ = 0.21** **F_{max} = 0.49** **F_{1998} = 0.41**[3]

[1]Weighted by stock biomass at age

[2]$F_{THRESHOLD} = F_{MSY} = 0.40$ on biomass when biomass = B_{MSY}. When biomass is between B_{MSY} and ½ B_{MSY}, $F_{THRESHOLD}$ is the maximum F that allows rebuilding to B_{MSY} in 10 years. When biomass is below ½ B_{MSY}, $F_{THRESHOLD}$=0.

[3]For fully recruited ages; in this case, the same as biomass-weighted F

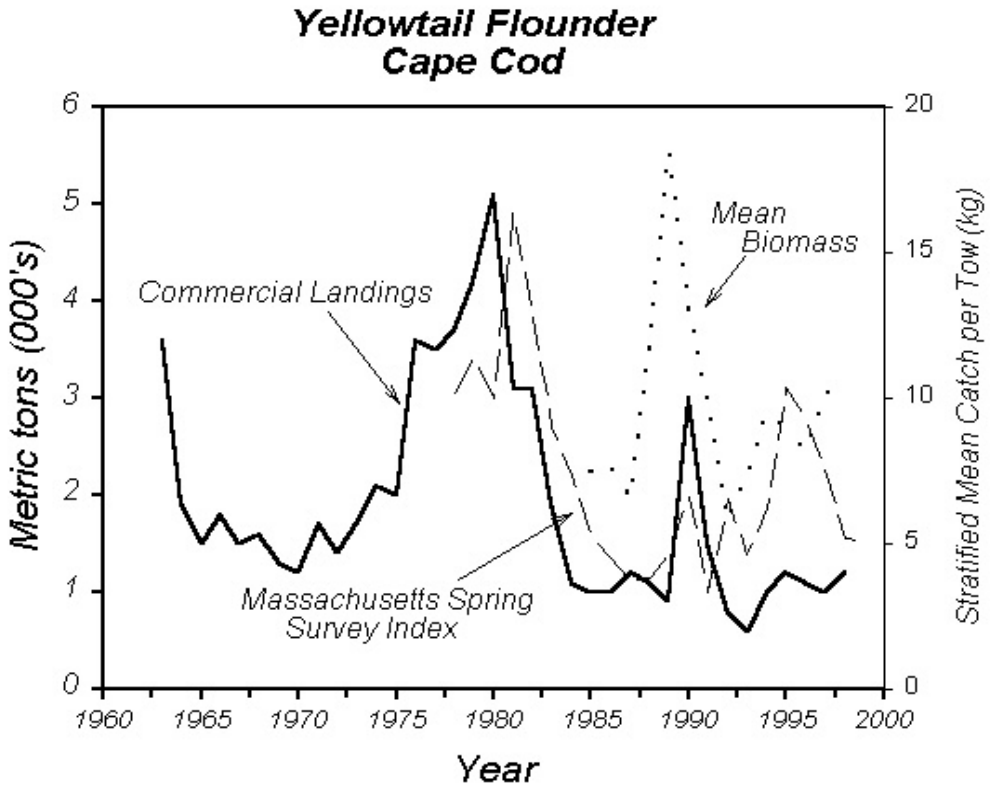

Table 7.3 Recreational catches and commercial landings (thousand metric tons)

Category	Year										
	1979-88 Average	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
U.S. recreational	-	-	-	-	-	-	-	-	-	-	-
Commercial											
United States	2.3	0.9	3.0	1.5	0.8	0.6	1.0	1.2	1.1	1.0	1.2
Canada	-	-	-	-	-	-	-	-	-	-	-
Other	-	-	-	-	-	-	-	-	-	-	-
Total nominal catch	2.3	0.9	3.0	1.5	0.8	0.6	1.0	1.2	1.1	1.0	1.2

Middle Atlantic

Trends for the Mid-Atlantic stock of yellowtail flounder have been generally similar to those observed for the southern New England stock. Landings declined from more than 8,000 mt in 1972 to less than 1,000 mt between 1976 and 1980. As a result of improved recruitment, landings increased from 300 mt in 1980 to 1,000 mt in 1984. Landings then declined and fluctuated between 200-500 mt annually from 1990 to 1998.

Prior to 1973, the average catch per tow in NEFSC autumn bottom trawl survey indices for the Mid-Atlantic was comparable to that on Georges Bank. Subsequent to the removal of more than 8,000 mt in 1972, survey indices fell to very low levels, with only slight increases in 1981-1982 and again in 1989-1990. Since 1991, survey indices have remained low.

A quantitative assessment is not available for this stock. Qualitatively, survey and catch data suggest continued low abundance. The survey biomass index for 1996-1998 was below the rebuilding target, and the catch-to-biomass ratio exceeded the management target chosen to allow stock rebuilding. The stock is considered to be overfished, and overfishing is occurring.

Summary Status

Long-term potential catch (MSY)	=	3,300 mt
Biomass corresponding to MSY	=	B_{MSY} = 9.1 kg/tow (autumn survey index)
Minimum biomass threshold	=	$^1/_2 B_{MSY}$ = 4.6 kg/tow
Stock Biomass in 1996-1998	=	0.15 kg/tow (Implies an overfished condition)
F_{MSY} proxy	=	0.36 (catch/biomass index)
$F_{TARGET98}$ proxy	=	0.00
Overfishing definition	=	$F_{THRESHOLD}$ = 0.00
$F_{1996\text{-}1998}$ [1]	=	2.0 (implies overfishing was occurring)
Age at 50% maturity	=	2.0 years, males 2.3 years, females
Size at 50% maturity	=	21.5 cm (8.5 in.), males 28.3 cm (11.1 in.), females
Assessment level	=	Index
Management	=	Multispecies FMP

M = 0.20 **$F_{0.1}$ = Unknown** **F_{max} = Unknown**

$F_{THRESHOLD}$=F_{MSY} =0.36, catch/biomass index when biomass= B_{MSY} ; decreasing linearly to zero at $B=^1/_2 B_{MSY}$.

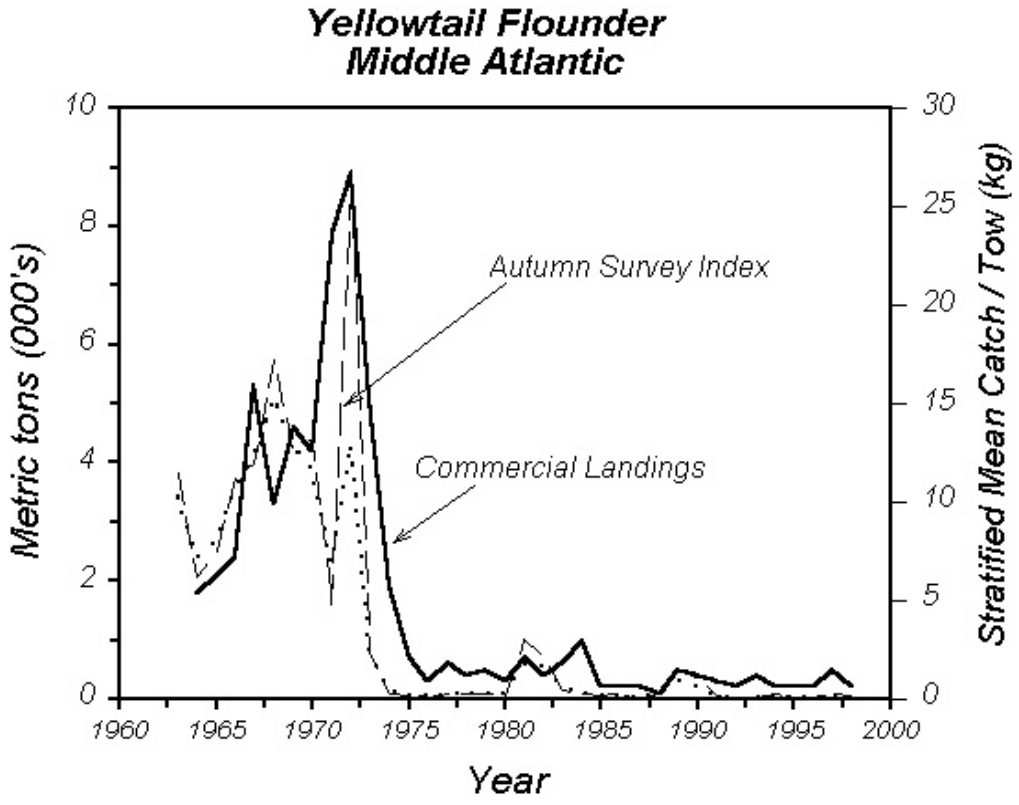

Table 7.4 Recreational catches and commercial landings (thousand metric tons)

Category	Year										
	1979-88 Average	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
U.S. recreational	-	-	-	-	-	-	-	-	-	-	-
Commercial											
United States	0.4	0.5	0.4	0.3	0.2	0.4	0.2	0.2	0.2	0.5	0.2
Canada	-	-	-	-	-	-	-	-	-	-	-
Other	-	-	-	-	-	-	-	-	-	-	-
Total nominal catch	0.4	0.5	0.4	0.3	0.2	0.4	0.2	0.2	0.2	0.5	0.2

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